


Fall 1987

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NSU Oceanographic Center

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# Currents

Fall 1987 Volume I Number 2



## REEFS, RADIOACTIVITY, AND RENOURISHMENT UNDER STUDY

**Dr. Richard Dodge** has undertaken several coral reef projects off South Florida and in the tropics in recent months. The problems associated with beach renourishment also have been under study.

In June Dr. Dodge was awarded a two-year grant by the National Science Foundation to look at fallout pollution from plutonium. Dr. Dodge has collected corals from Broward County's reefs and from reefs off Mexico and Panama for the study. Over the years, radio-active plutonium has been introduced into our oceans primarily by above-ground nuclear testing and by the reentry and disintegration of spent nuclear-powered satellites.

What does this have to do with corals? Simply stated, corals can provide an accurate history of past fallout levels, right down to the years in which the pollution occurred. Corals have growth rings, much as trees do, making such measurements possible. The technique used by Dr. Dodge and his colleagues is to cut a slice of coral with a band-saw, X-ray the slice, and then assign years to the growth bands seen on the X-rays. Various years of the skeleton are then cut away and subjected to



*Dr. Dodge assesses coral reef.*

radiochemical analysis (by **Dr. Larry Benninger** at UNC, Chapel Hill), to determine whether plutonium is present.

There is good reason for scientists, as well as the funding agencies, to be interested in plutonium. In the early days of radio-activity monitoring, Dr. Dodge relates, people were not

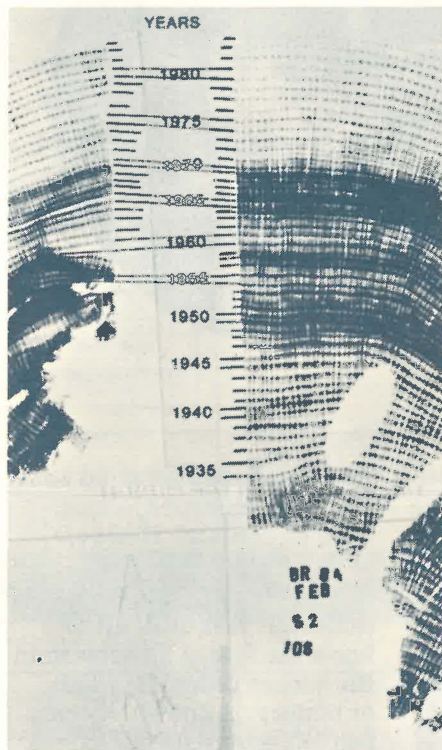
concerned about and did not routinely measure fallout from plutonium. However, today it is recognized as an extremely toxic and pervasive material. It is difficult to know the fate of plutonium in the oceans unless its input, or history, is known. Corals can tell scientists the extent of its past incursions, how it has degraded in the oceanic environment, and where it has ended up. An important question is whether plutonium stays in solution in seawater or whether it is quickly removed by biological processes. The trouble with plutonium, says Dr. Dodge, is that it has an extremely long half-life, and that it is so radioactive. "What do you do with it? It's just going to be nasty forever!"

Dr. Dodge also is interested in the problems associated with beach renourishment, a type of project that is becoming more and more

prevalent in areas of severe beach erosion. He has just completed a study of the growth rate of stony corals in reefs off Broward County, Florida, to evaluate the ecological effects of past beach renourishment projects.

Corals require specialized conditions for their growth, health and survival. During the renourishment process, sand is taken from offshore reefs and pumped onto the beach. The ocean turbidity that is caused by this activity can adversely affect the





Annual bands revealed in coral skeletons by X-radiography.

corals in a number of ways. Corals need sunlight, and turbid water, of course, diminishes the amount of light that reaches the reef. Rapid growth of the reef-building corals also is essential to the life of the reef so that the massive skeletons can form and endure. Symbiotic algae, called zooxanthellae, reside within the living tissue of coral animals. In return for their protective housing, the algae provide the coral animals with essential nutrients and assist with the removal of metabolic wastes. Should the reef environment become disturbed, this special relationship could be destroyed, and the health of the corals, and therefore the reef, would be in jeopardy.

The good news, according to Dr. Dodge, is that past Broward County beach renourishment projects appear to have had only minor, if any, effect on two species of coral currently living offshore. However, more research is needed to confirm these results and to acquire predictive information for use in future projects.

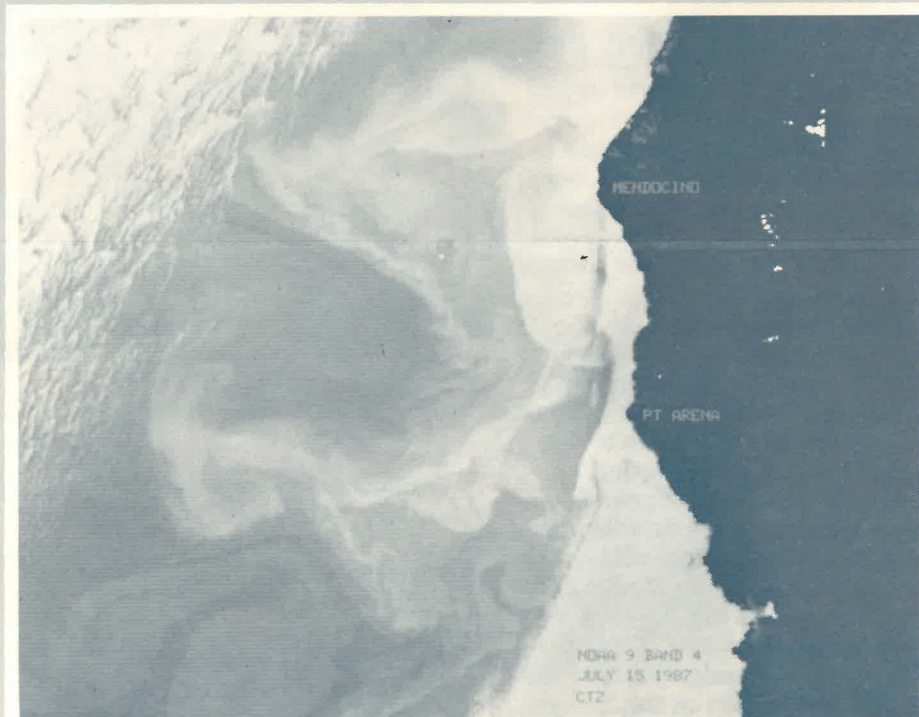
## "SQUIRTS" SEARCHED AND RESEARCHED

Dr. Gary Kleppel spent two weeks during July and August on the not-so-calm Pacific Ocean searching for and studying the biology and oceanography of "squirts." This may be something of a misnomer, because "squirts" are anything but small. They actually are vast filaments of coastal water that are "pushed out," or squirted, as far as 250 miles from the shores of Oregon and California, in effect transporting the coastal zone to the open Pacific (see satellite photo below). The region is fascinating scientifically and may have national security implications as well.

Cruise conditions were difficult, to say the least. Typical sea states were 8-12 feet, and they increased to 16-18 feet during mapping. When at one point 25-foot seas were encountered, the ship returned to port, much to the satisfaction of all onboard.

The cruise was sponsored jointly by ONR and NSF, and the vessel used was Moss Landing Research Lab's *Point Sur* (formerly University of Miami's *Cape Florida*). The region studied was the Coastal Transition Zone (CTZ) from Oregon to Point Reyes, California, out as far as about 255 miles from shore. Scientists used a prototype instrument called the Multi-frequency Acoustic Profiling System (MAPS) to map simultaneously the distributions of 40 different size classes of zooplankton, as well as temperature, conductivity, chlorophyll, and light. Dr. Kleppel's particular interest was to study the feeding and diet of zooplankton by measuring the animal and plant pigments in their stomachs.

According to Dr. Kleppel, the California Current region once was thought to be relatively easy to model. Now, with the advent of satellite imagery and the discovery of oceanic irregularities such as the "squirts," research tasks have become much more difficult, albeit exciting.



"Squirts" of coastal water extending 250 miles off the Oregon/California coast. (Satellite photo.)



# UNDERCURRENTS

## INSTITUTE OF MARINE AND COASTAL STUDIES

### How The "Father Of Marine Archaeology" Spends His Summer Vacations

It all began when **Dr. Richard Dodge**, who studies coral growth rings, got frustrated because no one could date parts of ships that had been found under some coral samples. And so it was that the Coastal Studies Institute asked **Peter Throckmorton**, the subject's "father," to abandon his seminar series at Harvard and teach a marine archaeology course at Nova. The course was designed for M.S. students who wanted some insight into this "new" field.

In Throckmorton's words, "Teaching a humanities course at an oceanographic institute, where most of the students have strong backgrounds in science but have not taken many history courses, was a challenge both for [myself] ... and for the students." As he describes the situation, in January through March of any year, Throckmorton can be seen wringing his hands and moaning, "They've never heard of Napoleon....," while the students can be heard moaning, "He's giving us too much to read...."

"Somehow, miraculously," he adds, in third person, "in the three years, both students and Throckmorton have enjoyed themselves, and everyone has learned a lot." One student, **Jerome Hall**, has enjoyed himself so much that he has decided to go on for his Ph.D. in Marine Archaeology under **George Bass** at Texas A&M, as soon as he finishes his M.S. thesis work for Nova.

Throckmorton has spent the last two seasons in the Dominican Republic working as Staff Archaeologist for North

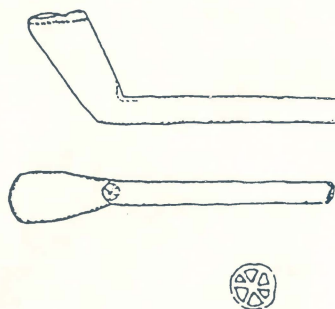
Caribbean Research, Ltd. (NCR), a group dedicated to researching ship wrecks. He has been assisted by Hall, who is busy gathering data for his thesis. So far NCR has located 26 ship wrecks and 6 survivor camps. The wrecks date from ca. 1640 to 1880. Illustrated below are some artifacts located by NCR archaeologists.

Hall has been working on what is locally known as the "Pipe Wreck," a.k.a. the "Dutch Wreck." Its cargo: clay pipes. Its location: Monte Christi, off the north coast of the D.R. Its date: ca. 1640. The approximate year of the wreck was arrived at by measuring the bores of 507 (of some 3000) pipe stems and fitting the data to an old established dating formula. This particular wreck is very popular among local divers, fishermen, and assorted treasure

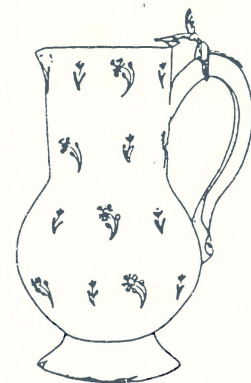
hunters. Hall writes that he has positively identified 8 pipes from the wreck that have shown up in flea markets in the capital.

In July of this year, at another site off Punta Luna, the NCR group found the wreck of what may have been a French troop transport, dated ca. 1797. The group located, among other typically French artifacts, a 30 x 20 foot ballast pile made up of 42-pound cannon balls. Also found were two bronze field artillery cannons. Both weapons bear the coat of arms of Louis XVI (shown below). The archaeologists now are trying to positively identify the ship, with the assistance of colleagues in France.

*Cont. on p. 7*



*"Dutch Bowl" pipe with medallion rosette.*



*Mid-18th century Rouen pitcher.*



# SPOTLIGHT

## NEWEST PH.D. CONTINUES STUDENT INVOLVEMENT

**Dr. Donald McCorquodale**, a native of Miami and a graduate of Florida Atlantic University, received his Ph.D. in Marine Biology from Nova's Oceanographic Center in June. We learn that he has been busy with other pursuits during the past few years, as well as working on his degree.

McCorquodale owns and operates Spectrum Laboratories in Fort Lauderdale. His concern is water pollution, and he works with water samples from both South Florida and the Bahamas. Currently his work is being sponsored by Dade County's Department of Environmental Regulations Management (DERM).

McCorquodale has developed a new method of monitoring fecal pollution in seawater: a coliphage technique. Coliphage is a virus that attacks *E. coli* (fecal bacteria) in seawater. His test is different from those used for the past several years in that he uses as an indicator a specific strain of *E. coli* that is particularly susceptible to attack by coliphage normally found in polluted seawater. Thus he has found an extremely effective way of determining whether fecal pollution is present in a given seawater sample. His method soon may be used by the state as a standard for judging water quality in coastal areas.

Although his formal work at Nova has been completed, McCorquodale looks forward to maintaining interaction with both faculty and students at the Oceanographic Center. He will continue to teach



*Dr. McCorquodale at work in his laboratory.*

"Aspects of Coastal Pollution" to Coastal Studies students (next offered in fall 1988). He enjoys all aspects of academic involvement and values his opportunities for continued research, which, he states, can help him become a better consultant and expand his own horizons.



*John DiTuro works with biological samples.*

## Pollution, Pollution, And More Pollution

Several M.S. students from Coastal Studies are employed by Dr. McCorquodale. He feels that employing graduate students on either a full-time or a part-time basis gives them valuable experience as they prepare for their careers in marine science.

Marine Biology student **John DiTuro**, for example, is studying the uptake and release of tert-methyl butyl ether from the water-soluble fraction of unleaded gasoline in sediments from Port Everglades, and from benthic polychaetes. He is researching a new method of analyzing his samples for a specific volatile hydrocarbon (MtBE) as an indicator of unleaded gasoline pollution. The method utilizes a specially constructed sediment sieve, an ultrasonicator, and a gas chromatograph/mass spectrometer (GC/MS). If DiTuro is successful in his efforts, this method could be used to form a marine pollution index for



monitoring marine sediments or for tracking the course of a gasoline spill.

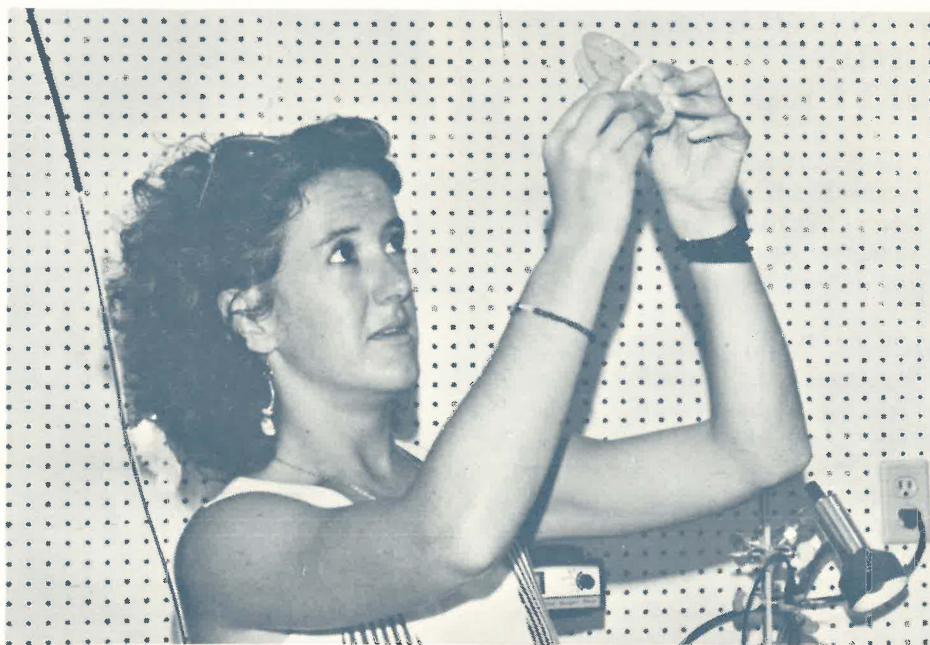
Another Nova M.S. student, **Carla Taeffner**, also works for Dr. McCorquodale. Her thesis research centers on corals. Due to the persistence of coral skeletons in the marine environment, they can be used as indicators of the past and present chemical composition of seawater. This process is possible because coral polyps incorporate trace elements from seawater into their skeletons during growth. Taeffner's research focuses on using cadmium as a tracer in coral skeletons.

As a tracer, cadmium can indicate past upwelling events along the Broward County coast or possible pollution that occurred during the growth period. Test corals are cleaned, dissolved, and analyzed for cadmium by means of graphite furnace, atomic absorption spectrophotometry.

Thus McCorquodale's lab provides a proving ground for battling marine pollution on many different levels and from all angles. If studies and experiments such as those just described continue to be productive, we may yet get an edge on the multitudes of pollutants out there.



**Carla Taeffner monitors cadmium tracers.**



**Isabel Puente checks water sample.**

## Fecal Matter One For Concern

**Isabel Puente**, an M.S. student in the Marine Biology program, has been a regular visitor to Dr. McCorquodale's lab, where she learned his unique method for monitoring fecal pollution in seawater. She now has set up her own lab in the Coastal Studies complex, where she is hard at work on her thesis research.

For her project, Puente is experimenting with a technique for determining the difference between human coliphage and other mammal coliphage in seawater, using McCorquodale's coliphage method. The question under investigation is whether or not coliphage from other mammals test positive, using the new pollution indicator. If they do not, then the test must be specific to human fecal pollution. Finding coliphage from a marine mammal in seawater samples is to be expected. But finding human coliphage in the region of, say, a sewage outfall or live-aboard docks is another matter, calling for serious investigation.

Because it will be necessary for Puente to obtain fecal samples from marine mammals for comparison purposes, she plans to go directly to the sources, such as manatee and dolphin tanks.

Puente already is thinking about going on for her Ph.D. in Marine Biology. She is here from Spain on a 5-year visa which, she says, is valid "as long as you study." She came here primarily to learn English. Then she saw a newspaper ad for Nova's Marine Biology program, and she quickly found herself learning considerably more than she had bargained for.

Born in Bilbao, Spain, Puente earned the B.S. degree close to home, at the University of Basque Provinces. She majored in biology and had an ecology minor. What better preparation for studying fecal pollution? Because the job situation is "bad" in her home country, Puente hopes that when she does finally return to Spain, she will be equipped with the education and experience that she will need to be competitive in her chosen field.



## WINTER TERM COURSE OFFERINGS

The Institute of Marine and Coastal Studies announces course offerings in the M.S. program for the winter term, which will run from January 4 to March 25, 1988.

### OC5601 Descriptive Marine Physics (Core Course; 3 credits)

A study of the physical properties of seawater, the temperature and salinity structure of the ocean, water masses and their circulation, wind waves and swell, tides and other long waves, geostrophic and frictional currents, and ice formation and movement.

### OC6080 Marine Invertebrates (3 credits)

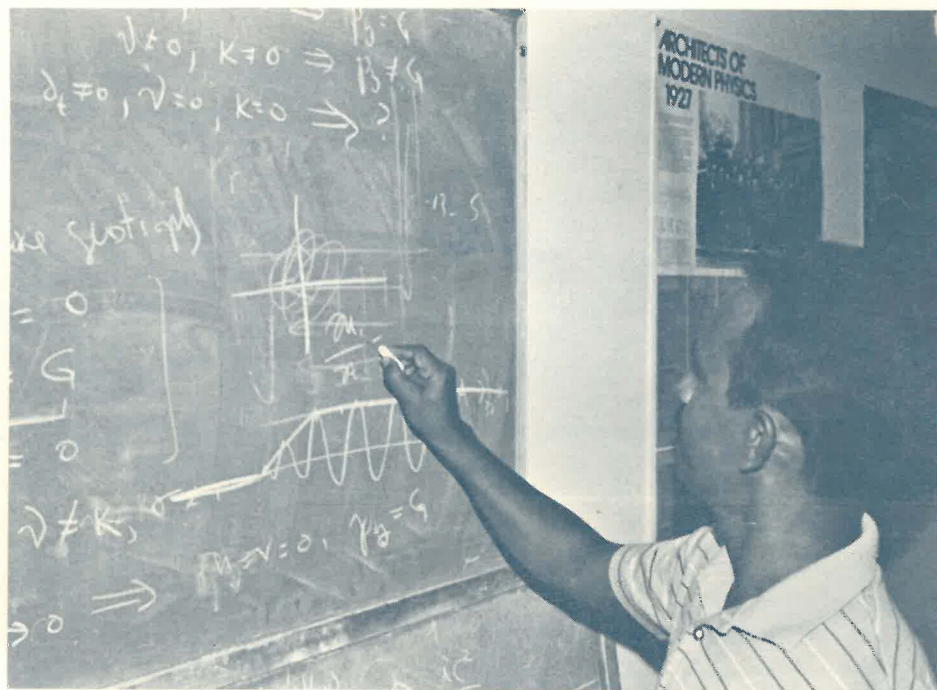
Studies of the important groups of planktonic and benthic invertebrates, with emphasis on their abundance, role in food webs and nutrient cycling, feeding and growth rates, productivity, reproduction, and interactions.

### OC6110 Biological Oceanographic Research Methods (3 credits)

Description and analysis of various research methods used in biological oceanography.

### CZM660 Marine Archaeology (3 credits)

The study of nautical antiquities, especially their detection and protection. Covers concepts related to the conservation of archaeological resources in the coastal zone as well as techniques relevant to underwater excavation, removal, and preservation of marine artifacts.



Professor Pijush Kundu formulating equations

## RECENT PUBLICATIONS

P. Blackwelder and S.B. Hooker,

1986. Summaries of data of a geologically significant phytoplankton subset from warm core rings and the Western North Atlantic (September 1981 - October 1982). Report #86-1, Nova Univ. Press, 109 pp.

P. Blackwelder and S.B.

Hooker, 1987. Distribution of geologically important phytoplankton in the NW Atlantic and in warm core rings. *Mar. Micropaleo.* (to be submitted).

G. Blaha, R.P. Bessett, and G.

Hadgigeorge, 1986. Global point-mass adjustment of the oceanic geoid based on satellite altimetry. *Mar. Geod.*, 10, 97-129.

G. Blaha, R.P. Bessett, and G.

Hadgigeorge, 1986. Collocation of resolution of the oceanic geoid based on satellite altimetry. *Mar. Geod.*, 10, 131-168.

C. Burney, 1986: Bacterial utilization of total *in situ* dissolved carbohydrate in offshore waters. *Limnol. Oceanogr.*, 31, 427-431.

C. Burney, 1986: Diel dissolved carbohydrate accumulations in coastal waters of South Florida, Bermuda and Oahu. *Estuarine, Coastal and Shelf Science*, 23, 197-203.

L.K. Benninger and R.E. Dodge, 1986. Fallout plutonium and natural radionuclides in annual bands of the coral *Montastrea annularis*, St. Croix, U.S. Virgin Islands. *Geochim. Cosmochim. Acta*, 50, 2785-2797.

R.E. Dodge, 1987. Growth rate of stony corals of Broward County, Florida: Effects from past renourishment projects. Report, Broward County Erosion Prevention District, 73 pp.

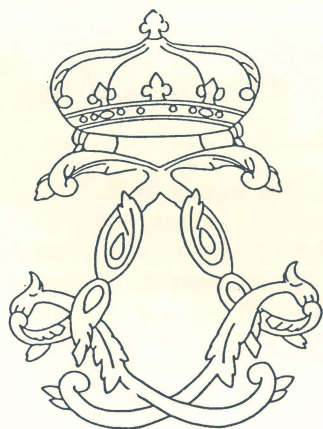
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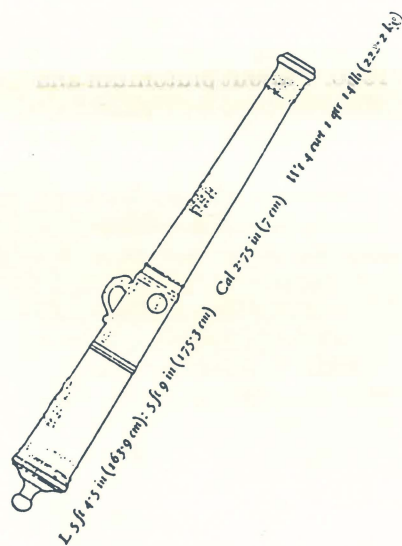
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On about October 15 a book entitled *The Sea Remembers*, edited by Throckmorton, will be published. This 200-page, generously illustrated volume (a Book-of-the-Month Club Alternate Christmas gift selection) gives a survey of what is going on today in marine archaeology.

Marine Archaeology will be offered again this winter term, January 4 to March 25. Field trips to local ship wrecks for "hands-on" experience will be arranged by Throckmorton.



Coat of arms of Louis XVI.  
(Illustrated by K. Maxson.)



Bronze cannon, ca. 1768.

## FACULTY/STAFF ON THE MOVE

**Dr. Pat Blackwelder** attended a meeting of the Electron Microscopy Society of America, held August 2-5 in Baltimore. She sponsored a talk entitled "The Presence of Iron-rich Particles in the Brain Dura of the Pygmy Whale" *Kogia breviceps*, which was presented by University of Miami student **Vicki Credle**.

Dr. Blackwelder also attended a meeting of the American Chemical Society in New Orleans, September 2-4. She participated in a planning session on future research in biomineralization.

Soon after returning from an Indian Ocean cruise, **Dr. Gary Hitchcock** traveled to Bigelow Laboratory, in West Boothbay Harbor, Maine, to attend a SYNOP meeting, Sept. 10-12. The group discussed Gulf Stream "shingles," or spinoff water filaments. Dr. Hitchcock's Indian Ocean cruise will be the subject of a feature article in the next issue of *Currents*.

**Dr. Gary Kleppel** returned to California to conduct the last 2 of a series of 11 experiments on the relation between diet and egg production in the important zooplanktonic copepod, *Acartia tonsa*. The species occurs in warm coastal and estuarine waters throughout the world and is a favorite food of larval and juvenile fishes. It has long been known that the number of eggs that a copepod produces depends on the amounts of food eaten and some basic environmental variables. More recent work, including Dr. Kleppel's study, shows that the kinds of food, not simply the amounts, also are important. For instance, copepods will eat both plants (algae) and animals, but they seem to produce more eggs

when they feed on algae. The study, which is funded by Sea Grant, is being conducted at the U.S.C. Marine Lab in Los Angeles.

**Dr. Julian McCreary**, Center Director, spent most of the summer out of Florida's heat. For 2 weeks in July he attended a conference on physical oceanography in Sao Paulo, Brazil. Most of August was spent in Seattle and in Vancouver, where he attended the two-week General Assembly of the International Union of Geodesy and Geophysics (IUGG) and presented a paper on equatorial oceanography. September was spent at the University of Hawaii with **Dr. Dennis W. Moore**, former director of the Oceanographic Center. They worked on a paper presenting the results of joint research on physical oceanography of the Indian Ocean.

**Dr. Georges Blaha** will attend the annual fall meeting of the American Geophysical Union (AGU), which will be held in San Francisco in early December.

**Jan Witte**, Research Associate, organized and attended a workshop on Ocean Color held in Annapolis, MD, September 29 - October 1. The meeting was sponsored by NASA/Goddard Space Flight Center.



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**G. Hitchcock**, 1987: Plankton biomass and the physical field in fronts of oceanic current systems. IN: *Proc. of the Internat. Conf. on the Marine Science of the Arabian Sea*, AIBS, Karachi, Pakistan (in press).

**G. Hitchcock**, 1987: Plankton biomass in relation to shelf water entrainment features along the Gulf Stream front. *Biol. Oceanogr.* (in press).

**G.S. Kleppel, R.E. Pieper, and G. Trager**, 1987. Variability in the gut contents of individual *Acartiatonsa* from waters of southern California. *Mar. Biol.* (in press).

**G. Kleppel**, 1987. Plant and animal pigments as trophodynamic indicators. IN: *Indicator Organisms in the Marine Environment*, D.F. Soule and G.S. Kleppel, Eds., Springer-Verlag, New York (in press).

**P. Kundu**, 1986. A two-dimensional model of inertial oscillations generated by a propagating wind field. *J. Phys. Oceanogr.*, 16, 1399-1411.

**P. Kundu and J.P. McCreary**, 1986. On the dynamics of the throughflow from the Pacific into the Indian Ocean. *J. Phys. Oceanogr.*, 16, 2191-2198.

**J.P. McCreary and P.K. Kundu**, 1987. Thermohaline forcing of eastern boundary currents: with application to the circulation off the west coast of Australia. *J. Mar. Res.*, 44, 71-92.

**J.P. McCreary**, 1987: A model of deep jets. IN: *Further Progress in Equatorial Oceanography*, E.J. Katz and J.M. Witte, Eds., Nova Univ. Press, Ft. Lauderdale, FL, 385-396.

**J.P. McCreary, P.K. Kundu and S.-Y. Chao**, 1987. On the dynamics of the California Current system. *J. Mar. Res.*, 45, 1-32.

**J.M. Witte**, 1986. *El Nino/ Southern Oscillation and Physical Processes of the Tropical Oceans: A Bibliography*, UCAR, Boulder, CO, U.S. TOGA Report No. 7, 175 pp.

**E.J. Katz and J.M. Witte, Eds.**, 1987. *Further Progress in Equatorial Oceanography: A Report of the U.S. TOGA Workshop on the Dynamics of the Equatorial Oceans*, held in Honolulu, HI, Aug. 11-15, 1986, Nova Univ. Press, Ft. Lauderdale, FL, 450 pp.

## Currents

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Editor: **Jan Witte**

Contributing Reporters:  
**Cathy Mattison**  
**Isabel Puente**

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